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Importance of convective overshooting troposphere to stratosphere transport in the tropics at the global scale

Jean-Pierre Pommereau
CNRS, LATMOS, Verrieres le Buisson, France (pommereau@aerov.jussieu.fr)

The occurrence of fast deep convective overshooting up to 450 K or 60 hPa over land in the tropical lower stratosphere and its impact on the thermal structure, the composition and the water vapour systematically reported during recent field observations in Brazil, Australia and Africa, is now generally accepted. However, though successfully captured by meso-scale cloud resolving model simulations, the mechanism is still ignored in NWPs and CCMs global models, because of the difficulty of including such small size (10 km) and short time (10-20 mn) events of high kinetic energy different from the usual scheme of Convective Available Potential Energy (CAPE)
Their possible contribution to troposphere-to-stratosphere transport at the global scale has been explored from the time variation of the concentration of two tracers in the equatorial lower stratosphere: N2O available from the ODIN Sub-Millimetre Radiometer and aerosols from the CALIPSO lidar. N2O is shown to display a minimum concentration in May-July, largely enhanced in May over the West Pacific compared to Africa, in coincidence with the maximum overshooting volume reported by the TRMM precipitation radar. The aerosols are showing fast uplift episodes of clean, likely washed-out, tropospheric air up to 20 km during the Southern Hemisphere convective season in February-March, followed by that of aerosols of unknown nature, possibly mineral dust, above Africa in April-May, then over South Asia in July-August.
Although the relative contributions of direct fast uplift of cold and heavy air at high altitude and local drain areas required for compensating the resulting energy sink are not fully understood yet, the fast velocity of these events and their average zonal signature strongly suggest a significant role of deep convective overshooting on troposphere-to-stratosphere transport at the global scale.